DEVICE FOR TRANSPORTING AND ALIGNING STACKS OF SHEET-SHAPED PRINT MATERIALS

BACKGROUND

(001) The invention relates to a device for transporting and centrally aligning stacks of sheet-shaped print materials.

(002) Typically, devices of the type named are used to move stacks of sheet-shaped materials, which will be bound or are already bound, from one processing station to the next in a print further processing device. What is important is that the sheet-shaped materials in the stack do not lose their alignment with respect to each other since otherwise errors would occur during the outside edge processing of the stack of sheet-shaped materials. Another error that could otherwise occur is that punched holes, e.g. for a wire comb binding, plastic comb binding or spiral binding, can slip, which leads to later problems when a corresponding binding element is threaded through.

(003) In many applications for binding stacks of sheet-shaped materials, it is necessary to guide the stack of sheet-shaped materials in a specific alignment through a corresponding device in order to ensure precise processing of the stack of sheet-shaped materials at different stations. This is especially the case if, in a digital printing machine, the individual pages of a print order are printed individually in sequence and then collected into the stack of sheet-shaped materials, which will be bound into a brochure or a book after that. In this process, the individual sheet-shaped materials that make up the stack are automatically collected against a stop. Usually this stop represents a more or less horizontal tray surface on which the individual pages are collected, but trays for vertical sheet-shaped materials are also known. Alternatively, devices are known that swing a stack of sheet-shaped materials from the horizontal position into a vertical position in order to make the stack available in this way for further processing stations.

(004) Different print orders now generally comprise a different number of printed pages. Because of this, generally there are stacks of sheet-shaped print materials of

different thicknesses. If these stacks of sheet-shaped print materials are then to be aligned symmetrically to the stack thickness for the subsequent processing procedures, each stack must be aligned according to its thickness, i.e. an offset of the position of half the stack thickness of such a stack would be necessary, which depends on the number of pages in a print order.

(005) Devices for transporting vertically aligned stacks of sheet-shaped materials are known from the state of the art. So, for example, the German OLS DE 22 26 455 shows a device for producing books from single-knife book binding machines. This device provides for transporting books from a single-knife book binding machine on a conveyor belt whereby at no point in the conveyor path is the book left unattended and especially does not cover distances in free fall. To do this, among other things two grippers are provided that grip the book on the cover on both sides. Thus, it is a case of transporting books that are already bound.

(006) Another conveyor device for book binding machines is disclosed in the German OLS DE 199 26 407. The device shown there relates to plate conveyors or studded chains or comparable conveying means in which the spacing between the chain bars of the studded chain is carried out automatically for the purpose of adapting to different book block thicknesses. In this process, the chain bars are linked to each other via a motor-driven double-threaded spindle. Because of this, the chain bars move, towards each other or away from each other, symmetrically with respect to the center of the book blocks. The book block thickness is determined by a measuring device during the setup operation and sent to the actuating elements as a reference. No alignment of the center of the book blocks relative to the transport path takes place.

(007) Another device for transferring book blocks to transport means of a book binding machine is found in the German OLS DE 100 45 401. Here as well, the book block is held on both sides by clamping elements. In addition, the device shown there makes it possible to align at least one corner of the spine of a book block held with frictional connection by relative displacement of the two sides of the book block in the plane of the book block into a defined position.

SUMMARY

(008) According various aspects of the invention, methods and devices are provided for transporting stacks of sheet-shaped print materials in a transport from a location misaligned with a reference axis to another location while aligning a center of a stack thickness with the reference axis.

BRIEF DESCRIPTION OF THE DRAWINGS

(009) Fig. 1 presents a schematic representation of a device according to an aspect of the invention in a starting position, and parts of a device from which the device according to an aspect of the invention takes the stack of sheet-shaped materials.

(010) Fig. 2 presents a schematic representation of the Figure 1 device when it is at half run-out, as well as parts of the device from which the Figure 1 device takes the stack of sheet-shaped materials.

(011) Fig. 3 presents a schematic end view of the Figure 1 device in a run-out position in contact with the stack of sheet-shaped materials on one side.

(012) Fig. 4 presents a schematic end view of the Figure 1 device in a run-out position in contact with the stack of sheet-shaped materials on both sides.

(013) Fig. 5 presents a schematic end view of the Figure 1 device in a starting position with a stack of sheet-shaped materials aligned centrally.

DETAILED DESCRIPTION

(014) Various aspects of the invention are now presented with reference to Figures 1-5, which are not drawn to any particular scale, and wherein like components in the numerous views are numbered alike. Generally known drive and/or guiding means, cams or electronic elements required for operating the devices described herein are shown only schematically and/or are only described in a general way. Referring now to Figure 1, a stack of sheet-shaped materials 1 with a stack thickness D and a center line MB of the stack of sheet-shaped materials is held by a collecting device 2, which is only

partially shown, for providing stacks of sheet-shaped materials in vertical position. This device 2 for providing stacks of sheet-shaped materials 1 may be e.g. a collecting device for sheet-shaped materials. In such a collecting device 2, typically the sheet-shaped materials are collected horizontally on a tray surface and then if necessary tipped into a vertical position using a suitable tong apparatus. The stack of sheet-shaped materials 1 is in contact here with the tong element 10. Below the tong element 10, there is a bracket guide 12 for the clamping jaws 20. Alternatively, it could also be another guide known to the person skilled in the art.

(015) Figure 1 shows a device 100 according to an aspect of the invention in its starting position. Here clamping jaws 20, 20' are located in the area of a tray surface 50, which is part of a vibrating table. The vibrating table has a drive marked with a reference character 52. The clamping jaws 20, 20' are each mounted on a tong body 24, 24'. The clamping jaws 20, 20' and the tong bodies 24, 24' are connected to a carriage 30 (see Figure 3). The carriage 30 can be moved by a drive 46, by means of tong carriers 42, 42', along the sliding rails 47, 47' in a transport direction. The carriage 30 is also guided laterally with respect to a transport direction. The position of the tong carriers 42, 42' is controlled, among other things, by an optical switch 48 (see Figure 2). A first clamping jaw 20 has an upper guide mandrel 22, on the tip of which a running wheel 23 is mounted (see Figure 3).

(016) Figure 2 shows the carriage 30 when it is half run out, just before the upper guide mandrel 22 moves, along with the running wheel 23, into the bracket guide 12. The carriage 30 has on its underside a second lower guide mandrel 33 that is in contact with a bracket guide 44, 44'. The bracket guide 44' tracks laterally toward the first clamping jaw 20 (to the left in Figure 2) so that further movement of the device 100 presses the carriage 30 laterally in the direction of the first clamping jaw 20, until the running wheel 23 is aligned with the bracket guide 12. As soon as the guide mandrel 22 is in contact with the bracket guide 12 of the clamping jaw 20, the lower guide mandrel 33 is released from the bracket guide 44. Furthermore, at this point, the distance between the clamping jaws 20, 20' is maximized. The rest of the function sequence of the device

100 according to the invention will be explained step by step with reference to Figures 3 to 5.

(017) Figure 3 shows an end view of the device 100 according to the invention in a position in which the clamping jaws 20, 20' are engaged as much as possible into the device 2, especially far enough so that the clamping jaws 20, 20' can grasp the stack of sheet-shaped materials 1 over its entire length. In this position, first clamping jaw 20 is located in the same plane as the tong element 10, namely in contact with the outside of the stack of sheet-shaped materials 1. As can be seen in Figure 3, the center line M of device 100 is offset somewhat to the right of the center of the stack of sheet-shaped materials MB. By continuation of the bracket guide 44' in combination with maximizing the distance between the clamping jaws 20, 20', as described above, the clamping jaws are aligned so that the center line MS of the carriage 30 lies on the right relative to the center line M of the device 100 and the center line MB of the stack of sheet-shaped materials 1.

(018) The first and second tong bodies 24, 24' are each connected by way of a first lever 26, 26', as well as a second lever 28, 28', to the carriage 30. A drive that is not shown is mounted on the carriage 30 between these levers 26, 26', 28, 28'. This drive simultaneously moves a first linkage rod 31, which is connected at a first linking point 29 with the first lever 26 of the left clamping jaw, and a second linkage rod 31', which is connected at a second linking point 29' with the first lever 26' of the second clamping jaw 20'. In particular the linkage rods 31, 31', constitute a mutual double-threaded rod.

(019) If the drive, which is not shown, now moves the linkage rods 31, 31', the linking points 29, 29' move toward each other or away from each other according to the direction of rotation of linkage rods 31, 31'. Both linking points 29, 29' move, in this case, by the same amount toward the center line MS of the carriage 30 or away from it. Because of this, the positions of the first clamping jaw 20 and the second clamping jaw 20' also continuously remain symmetrical to the center line MS of the carriage 30. If the drive, which is not shown, is now used to close the clamping jaws in this position of the carriage, the carriage 30 must necessarily move toward the left since the first clamping

jaw 20 is already contacting the stack of sheet-shaped materials 1. Since the clamping jaws 20, 20' are continuously moved symmetrically to the center line MS of the carriage 30, as described, at the moment when the second clamping jaw 20' comes into contact with the stack 1, the center line of the carriage MS necessarily coincides with the center line MB of the stack 1 (see Figure 4). In addition, the clamping jaws 20, 20' have insertion aids 21, 21' in the front area turned toward the device 2.

(020) At a signal from the device 100, the device that has made the stack of sheet-shaped materials 1 available releases the stack of sheet-shaped materials 1 as soon as the clamping jaws 20, 20' have securely gripped the stack of sheet-shaped materials 1. After that, the carriage 30 moves, together with the clamping arrangement and the stack 1, back into the initial position of the device 100. During the return travel, the guide mandrel 33 visible in Figure 2 in turn engages in the bracket guide of the carriage 44, 44' so that the carriage 30, together with its freight, is moved laterally, during the movement in transport direction, far enough so that the center line M of the device 100 coincides with the center lines MB of the stack of sheet-shaped materials 1 and the center line MS of the carriage 30 that already coincide with each other (see Figure 5). In this position, the stack of sheet-shaped materials is already centered over the tray 50 of the vibrating table. At this point, the stack of sheet-shaped materials 1 can be taken over by another device, which is not shown for transporting the sheet-shaped materials.

(021) One of the linkage rods 31, 31' has a shaft encoder, which is not shown, that sends the rotary movement of the linkage rods 31, 31' to a higher-level control, which is not shown. From the signals from the shaft encoder, this control determines the distance between the clamping jaws 20, 20'. When the tongs are closed, this distance corresponds exactly to the stack thickness D of the stack of sheet-shaped materials 1. In a first operating mode, in which as just described a stack of sheet-shaped print materials 1 is transported from the device 2, it is provided that a holding force of the clamping jaws 20, 20' of at least 160 N will be generated in order to ensure that there is no slipping of the individual sheet-shaped materials in the stack 1. In a second operating mode of the device 100, in which a stack of sheet-shaped materials 1 is not to be taken over by the device 2, rather a stack of sheet-shaped materials 1 is manually

placed in order to make this stack 1 available to devices that follow on the transport path of the device 100, the device 100 is only used to determine the stack thickness of the manually placed stack 1. In this operating mode, the clamping jaws 20, 20' remain in a slightly open position laterally above the tray 50 and at first are used to prevent disarrangement of the sheets by the user that places the stack of sheet-shaped materials 1 in the device 100 manually. The sheet-shaped materials that are manually placed in the device 100 in this way are straightened at the tray 50 of the vibrating table. Then the clamping jaws 20, 20' move together with a maximum holding force of 40 N to determine the stack thickness D of the manually placed stack of sheet-shaped materials 1 in order to make the information regarding the stack thickness D available to the device that follows the device 100. The determination of the stack thickness D is carried out in this second operating mode the same as in the first operating mode, only with reduced holding force since, on one hand, an elevated holding force is not necessary since the stack of sheet-shaped materials 1 does not have to be transported and, on the other, in order to prevent injury to a user during the measurement of the stack thickness D. As an additional safety measure, a photoelectric barrier is provided that monitors the upper area above the stack of sheet-shaped materials.

(022) The second clamping jaw 20' is rocker-mounted at 19, with a spring (not shown) for compensating variations in the thickness of stack thickness D. The rocker is pressed outward upon contact with the stack of sheet-shaped materials 1 and the further closing of the clamping jaws 20, 20', whereby the springs of the rocker mounting are pre-stressed. In addition, an optical switch, which is not shown, is provided that monitors the position of the rocker. Advantageously, the optical switch is designed in such a way, and coordinated with the rocker springs in such a way, that the movement of the clamping jaws 20, 20' is switched off together with the rocker when a specified holding force is reached. This holding force corresponds either to the 160 N that is required for the transport of the stack of sheet-shaped materials or the 40 N for thickness measurement without transport of the stack of sheet-shaped materials 1.

(023) At the same time, a signal from this optical switch that corresponds to the closed status of the tongs can be used in order to signal the collecting device that the device

100 is now securely holding the stack of sheet-shaped materials and the collecting device can release the stack of sheet-shaped materials 1. Alternatively, a "tongs closed" signal can be generated so that the device that has made the stack of sheet-shaped print materials 1 available releases it when the sensor that monitors the movement of the clamping jaws 20, 20' toward each other no longer supplies any pulses. The clamping jaws 20, 20' are then necessarily closed.

(024) The alignment of the clamping jaws 20, 20' and the stack of sheet-shaped materials in the transport direction may carried out independently of the stack thickness. Because of this, it is possible to achieve the alignment of the stack of sheet-shaped materials in an especially flexible way, especially for a change between different print orders that create stacks of sheet-shaped materials with different thicknesses. The maximum thickness of the stack of sheet-shaped materials depends on the clamping force that the device according to the invention can make available for clamping the stack of sheet-shaped materials. In addition, the maximum thickness of the stack depends on the movement capability of the clamping jaws, especially on the distance that these clamping jaws can move with respect to each other. The thickness of the stack is also limited by the subsequent processing steps. If the sheet-shaped materials are bound after transport, e.g. by means of wire comb binding, stapling, adhesive binding, spiral binding or other binding processes, the available binding element also restricts the thickness of the stack.

(025) The sheet-shaped materials may be clamped so that they are vertical between the clamping jaws. On one hand, this results in special demands on the available holding force of the clamping jaws since the sheet-shaped materials in the stack must be pressed together in such a way that they are not displaced with respect to each other because of their inherent weight; on the other hand, the vertical position of the sheet-shaped materials in the stack, which generally consist of flexible material, e.g. paper, prevents the stack from deforming, i.e. from deviating from a shape that is essentially square.

(026) The clamping jaws may be linked with the carriage and to each other by way of a parallelogram. Advantageously, the carriage thereby remains continuously centered between the clamping jaws. In this way, a superimposing of the center lines of the stack of sheet-shaped materials and the center line of the carriage can be achieved in a simple way.

(027) The device 100 may be open on both sides of the stack of sheet-shaped materials. This means the clamping jaws only grip the stack on the side and permit running in laterally, around a stack of sheet-shaped materials, e.g. in order to take the stack out of the device 2, and, on the other hand, in order to move the clamping jaws laterally away from the stack so that after transport and delivery of the stack to the next device in sequence, the clamping jaws can move back to their starting position. In this way, the necessity of the clamping jaws carrying out a vertical movement is dispensed with.

(028) At least one of the clamping jaws may be mounted in such a way that the clamping jaws adapt to stacks of sheet-shaped materials that are not uniform in thickness. This is especially important if the stack consists of printed sheet-shaped materials. Because of uneven toner application, in some cases there can be considerable variations in the thickness of a stack over its area. By using a rocker-like mounting for at least one of the clamping jaws, it is possible to compensate such variations in thickness and attain a holding force that is distributed uniformly along the clamping jaw surfaces.

(029) The device may have measuring devices, by means of which the thickness of the stack of sheet-shaped materials is determined. Advantageously, measurement of the stack thickness can be carried out even without transporting the stack of sheet-shaped materials. In one embodiment, the measuring device is a sensor disk that is coupled to the movement of the clamping jaws. Advantageously, measurement of the stack thickness is carried out at first with a maximum pressure of 40 N.

(030) The device may have a protective device that can switch off the clamping movement. In particular, the protective device contains a photoelectric barrier that

monitors the space above the stack of sheet-shaped materials that is clamped in the clamping jaws.

(031) The device may take the stack of sheet-shaped materials out of a collecting device for sheet-shaped materials.

(032) Although the invention has been described and illustrated with reference to specific illustrative embodiments thereof, it is not intended that the invention be limited to those illustrative embodiments. Those skilled in the art will recognize that variations and modifications can be made without departing from the true scope and spirit of the invention as defined by the claims that follow. It is therefore intended to include within the invention all such variations and modifications as fall within the scope of the appended claims and equivalents thereof.